

Cyclone activities over northwestern Pacific in the high resolution general circulation climate model (MIROC4h)

HAYASAKI, Masamitsu^{1*}, Ryuichi KAWAMURA¹, Masato MORI², Masahiro WATANABE²

¹University of Toyama, ²University of Tokyo

We examine cyclone activities over northwestern Pacific obtained from the Model for Interdisciplinary Research on Climate (MIROC) version 4. The MIROC4h consist five model components (atmosphere, land-surface, river-routine, ocean, and sea-ice subsystems). The spatial resolution in the atmospheric components have T213 spectral truncation (approx. 60 km interval) with 56-layer sigma coordinate below 40 km altitude. To evaluate the effect of air-sea interaction to the cyclone activities, we use three experiments of MIROC4h: (1) control run (fixed external forcing based on observations in 1950, (2) 20th century run (changing external forcing from 1950 to 2007, hereafter 20C3M), and (3) assimilated run with the observed ocean hydrographic data (ODAS, see Ishii and Kimoto, 2009 J. Oceanogr.). More details of the experimental design are documented in Tatebe et al. (JMSJ, in press). Cyclone activities are assessed by 6-hourly history of all cyclones (SLP at cyclone center, date and geographical points of generating, maximum deepening, and dissipating cyclones) by using an objective algorithm for detecting/tracking cyclones developed by Serreze et al. (1993).

Climatological monthly mean conditions of atmospheric and oceanic fields in the two experiments (20C3M and ODAS) show a good agreement with the observed characteristics of that in the Japanese 25-year Reanalysis/Japan Meteorological Agency Climate Data Assimilation System (JRA25/JCDAS). In late spring (Apr, May), however, intensity of the Aleutian low is slightly stronger than that in JRA25. Frequency of rapidly deepening cyclones on Apr-May is twice- or three-times as that in JRA25.

The rapidly deepening cyclones are frequently observed around Japan for cold season (Yoshida and Asuma, 2004 MWR). As noted by Yoshiike and Kawamura (2009 JGR), maximum deepening points of the cyclones tend to concentrate along the Kuroshio-Oyashio Extension during strong winter monsoon period. To examine atmospheric- and oceanic response by changing monsoonal flows, we demonstrate composite analysis of the positive/negative phase of monsoon activities using calculated atmospheric- and oceanic variables in 20C3M and ODAS run. In the strong monsoon period, we can find well-known characteristics both in 20C3M and ODAS experiments: (1) enhanced northerly and northwesterly wind covers over northeast China, East China Sea, Korean Peninsula, and Japan, (2) intensified East Asia jet elongate eastward, and (3) increased latent and sensible heat flux along ocean frontal zone. In cyclone activities (frequency, intensity, geographical distribution of maximum deepening points), however, there are no significant differences between strong and weak monsoon phases. These results suggest that air-sea interaction in MIROC4h is insufficient to change synoptic eddy activities over northwestern Pacific.

Keywords: air-sea interaction, synoptic scale eddy activity